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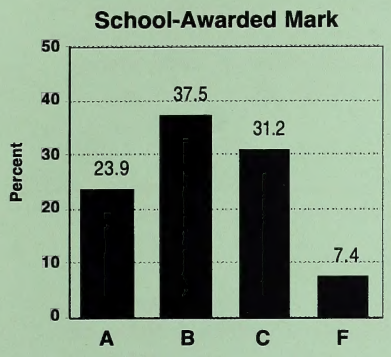
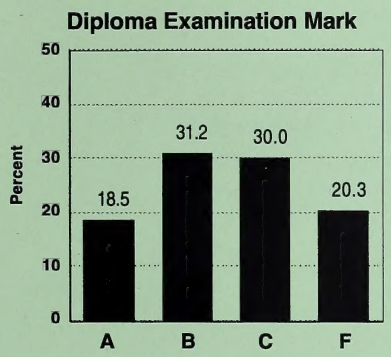
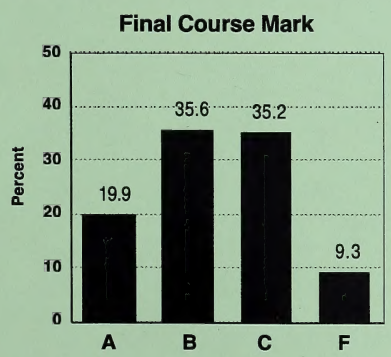
Biology 30

Diploma Examination Results
Examiners' Report for January 1995







The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1995 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 examination consists of 48 multiple-choice questions worth 60%, 8 numerical-response questions worth 10%, and 2 written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 7 762 students in Alberta who wrote the January 1995 examination. This represents a decrease of 777 students compared to January 1994 and a decrease of 2 157 students compared to January 1993.

- 90.7% of the 7 762 students achieved the acceptable standard (a final course mark of 50% or higher).
- 19.9% of the 7 762 students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was good. Although the implementation of the new program of studies for Biology 30 makes comparisons to past years difficult, the percentage of students who achieved the acceptable standard (90.7%) was nearly identical to January 1994 (90.6%). Most students demonstrated a good understanding of reproductive systems, reproductive hormones, and fetal development. Many students demonstrated comprehension of cell division, Mendelian and population genetics, and interaction between populations. Many students were able to describe and evaluate technological solutions to practical problems and apply skills and knowledge acquired in Biology to everyday life. Some students had difficulty with concepts related to the nervous and endocrine systems and with those related to molecular genetics.

Approximately 57.7% of the students who wrote the examination were female. Approximately 79.7% of this female population achieved the acceptable standard on the examination, as did 79.7% of the male population. Approximately 18.9% of this female population achieved the standard of excellence on the examination, compared to 18.1% of the male population.

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Student Evaluation

Alberta
EDUCATION

Provincial Averages

- The average school-awarded mark was 68.2%.
- The average diploma examination mark was 63.7%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 66.4%.

Approximately 7.8% of the students who wrote the examination in January 1995 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the August 1993 to August 1994 period. This subpopulation (602) achieved an examination average of 54.7%, compared to 64.5% for the population (7 160) whose first writing of a Biology 30 examination was in January 1995. However, the group of students who rewrote (602) increased their examination average score from 47.8% to 54.7%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the percentage of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations.

Knowledge–
- GLE 1 Nervous & Endocrine Systems
- GLE 2 Reproductive Systems & Hormones
- GLE 3 Differentiation & Development
- GLE 4 Cell Division & Mendelian Genetics
- GLE 5 Molecular Genetics
- GLE 6 Population Genetics & Interaction

Skills–
- SPSC Scientific Process Skills and Communication Skills.

Science, Technology, Society–
- STS Connections Among Science, Technology, & Society.

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC 1	B	48.7	√						√	
MC 2	B	71.2	√							
MC 3	D	69.1	√						√	
MC 4	A	45.3					√			
NR 1	5471	31.7	√							
MC 5	D	62.2	√							√
MC 6	C	65.8	√							
MC 7	B	76.7	√							
MC 8	B	53.2	√							
MC 9	C	66.2	√							
NR 2	2367	54.7	√							√
MC 10	D	84.9	√							
MC 11	A	43.2					√			
MC 12	D	56.1					√			
MC 13	B	71.7					√			
WR 1		59.6	√	√					√	√
MC 14	A	66.8		√						
MC 15	C	86.4		√						
MC 16	A	93.2		√						
MC 17	C	76.6		√						√

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC18	B	79.6		√						
MC19	A	63.1			√					√
MC20	C	89.1			√					√
MC21	D	92.8			√					
MC22	B	82.9			√					
MC23	A	81.3			√					√
MC24	D	70.8			√					√
MC25	B	55.9			√				√	
MC26	D	64.2						√	√	
MC27	B	83.4						√	√	
MC28	A	81.1						√	√	
MC29	B	71.4						√	√	
MC30	D	42.0						√	√	
MC31	A	63.9						√		√
MC32	D	64.5						√		√
MC33	D	74.5						√	√	
MC34	C	44.4						√		
NR3	875	81.4						√	√	
NR4	4.0	48.0						√	√	
MC35	C	69.1				√				
MC36	A	80.2				√				
MC37	D	75.9				√				
MC38	B	71.7					√			
MC39	B	60.6				√			√	
MC40	C	75.8				√				√
MC41	A	41.9				√				
MC42	C	84.9				√				
NR5	0.50	74.3				√			√	
MC43	A	79.1				√			√	
MC44	C	73.3				√			√	
NR6	857	52.0				√			√	
MC45	B	65.1				√				√
MC46	C	38.6					√			
MC47	C	57.5				√			√	√
NR7	10	24.4						√	√	
MC48	A	63.1				√			√	√
NR8	0.50	65.9				√			√	
WR2		52.9	√	√	√	√	√	√	√	√

Subtest: Multiple Choice and Numerical Response

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

- Multiple choice and numerical response: 37.1 out of 56
- General Learner Expectations

GLE 1	Nervous & Endocrine Systems	6.8	out of	11
GLE 2	Reproductive Systems & Hormones	4.0	out of	5
GLE 3	Differentiation & Development	5.4	out of	7
GLE 4	Cell Division & Mendelian Genetics	10.2	out of	15
GLE 5	Molecular Genetics	3.3	out of	6
GLE 6	Population Genetics & Interaction	7.4	out of	12
Skills		12.7	out of	20
STS		8.2	out of	12

- Multiple choice: 32.8 out of 48
- Numerical response: 4.3 out of 8

Subtest: Written Response

Results are in average raw scores.

- Written Response: 13.7 out of 24
- Question 1: 7.1 out of 12
- Question 2: 6.3 out of 12

Possible Symptoms of Diabetes Mellitus

1 Increased insulin production
2 Decreased insulin production
3 Increased blood glucose level
4 Decreased blood glucose level
5 Increased cellular absorption of glucose
6 Decreased cellular absorption of glucose
7 Increased urine production
8 Decreased urine production

Numerical Response

2. Pat, a 14 year-old student, has diabetes mellitus. Which four of these symptoms would Pat likely show, if untreated?

Answer: 2367

(Record your four-digit answer in ascending numerical order in the numerical-response section of the answer sheet.)

Numerical-response question 2 required students to analyze a list of possible symptoms and select only those that would be apparent in a person with untreated diabetes mellitus. Most students (about 90%) recognized that diabetes mellitus is associated with decreased insulin production. An analysis of the responses created by students indicated that many students did not logically apply this knowledge to determine the other symptoms of diabetes. About 25% of the students who wrote the examination correctly identified only three of the symptoms. Nearly 50% of these students indicated incorrectly that increased cellular absorption of glucose would be the fourth symptom. Approximately 25% of the students who correctly identified three symptoms indicated incorrectly that decreased blood glucose level would be the fourth symptom.

Amino Acid Sequence in Insulin

Dr. Frederick Sanger and his colleagues in England worked out the exact sequence of 51 amino acids in the insulin molecule. One part of that sequence of amino acids is:

— alanine — lysine — proline — threonine —

11. Which sequence of nitrogen bases in DNA encodes information to make this part of the insulin molecule?

•**A.** — CGA — TTT — GGT — TGA —
B. — CGT — AAA — GGT — ACT —
C. — GCU — AAA — CCA — ACU —
D. — GCG — AAG — CCA — ACG —

Multiple-choice question 11 required students to analyze a sequence of amino acids, determine the mRNA codons for that sequence, and then decode this information to determine the sequence of nitrogen bases in DNA. About 52% of students who wrote the examination chose either alternative C or D. These students did not recognize that two steps were required to solve this problem and, therefore, did not decode the mRNA sequence to determine the DNA sequence.

A Reproductive Technology

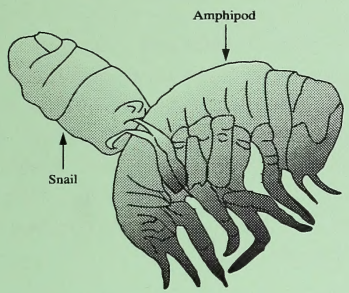
Reproductive technology may be used when people have difficulty conceiving children.
In vitro fertilization (IVF) is a procedure in which eggs are removed from a woman's ovary and placed in a culture dish containing sperm from a male donor. After fertilization occurs, an embryo is inserted into the uterus through the vagina.

19. The female menstrual cycle has several phases. Implantation of the fertilized egg in the IVF procedure would have the greatest chance of success if it were done during the

•**A.** corpus luteal phase when progesterone levels are high
B. corpus luteal phase when FSH levels are high
C. follicular phase when estrogen levels are high
D. follicular phase when LH levels are high

Multiple-choice question 19 required students to analyze a technology and apply knowledge of the variations in hormone levels during a typical menstrual cycle to determine when *in vitro* fertilization would have the greatest chance of success. Most students (about 80%) realized that either of the ovarian hormones can play an important role in the development of the endometrium before implantation. Those students with an understanding of the sequence of events in the menstrual cycle and in fetal development correctly chose progesterone. Of the students who failed the examination, about 38% did not recognize the importance of either ovarian hormone in the development of the endometrium and chose one of the gonadotropins.

An Amphipod with a "Piggy-Backing" Snail



In the Antarctic, James McClintock noticed that small amphipods (crustaceans) captured small free-floating snails. The snails were bright orange in colour and half the size of the amphipods. An amphipod held a snail on its back with 4 of its 14 legs. The snails were released unharmed when it got dark.

In a laboratory, McClintock separated populations of snails from populations of amphipods and placed some small fish with each group. The fish ate the amphipods but ate only a few of the snails and immediately spit them out.

When amphipods with snails on their backs were placed in the tank that originally contained snails, the fish did not eat the amphipods and actually avoided them. McClintock ground up some snails and formed them into pellets to feed the fish. When these pellets were fed to the fish, they immediately spit them out.

32. Why did the fish **not** eat the amphipods with snails on their backs?

A. The snails provided camouflage for the amphipods.
B. The fish learned to avoid the amphipods because the amphipods mimicked the snails.
C. The foul taste of the snails was absorbed by the amphipods and the fish learned to avoid them.
•**D.** The fish avoided eating amphipods carrying snails because they recognized the warning coloration.

Multiple-choice question 32 required students to analyze some data from an experiment and apply their knowledge of interactions between organisms. Most students (about 90%) determined that camouflage or mimicry were not responsible for the observed behaviour of the fish. Of the students who failed the examination, about 39% chose alternative C. They did not recognize that, in the last stage of the experiment, the fish did not eat the amphipods and therefore could not have sensed any residual taste of the snails.

Hemophilia is a disorder characterized by abnormal blood clotting. This disorder is an X-linked recessive trait.

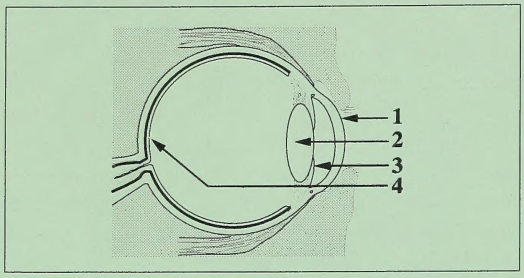
Numerical Response

8. A normal woman whose father had hemophilia is married to a man who has hemophilia. If they have a child, what is the probability that the child would have hemophilia?

Answer: 0.50

(Record a value from 0 to 1, rounded to two significant digits, in the numerical-response section of the answer sheet.)

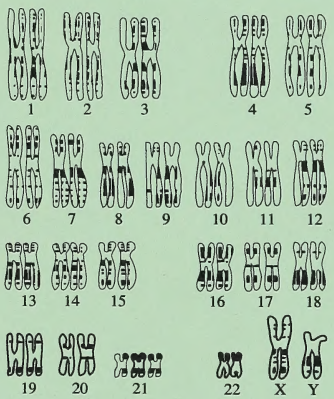
Numerical-response question 8 required students to interpret data, apply knowledge of genetics, and calculate the probability of the occurrence of a particular event. Of the students who achieved the standard of excellence on the examination, about 91% answered correctly. Of the students who failed the examination, about 38% answered correctly. About 3% of the students who wrote the examination reported the answer as a percentage rather than a probability.



5. Many blind people have damaged sensory receptors in the eyes but undamaged optic nerves. To assist these people, an artificial eye would have to replace the function of which structure shown in the diagram?

A. 1
B. 2
C. 3
•**D.** 4

An Abnormal Karyotype from a Human



40. Which technology would be best suited to identify a fetus with this disorder?

A. Ultrasound
B. X-ray imaging
•**C.** Amniocentesis
D. DNA fingerprinting

Multiple-choice questions 5 and 40 each required students to make a connection between a biological concept and the use of a technology.

About 56% of the females and 71% of the males who wrote the examination answered **question 5** correctly. About 24% of the females and 17% of the males who wrote the examination chose alternative B. Of the three incorrect answers, alternative B was chosen most frequently by both males and females. Therefore, it would seem that the context of the question did not introduce a gender bias.

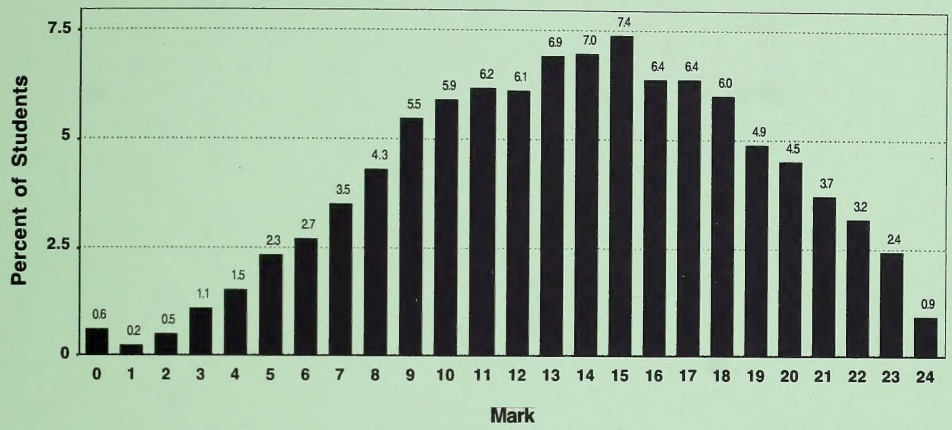
About 81% of the females and 68% of the males who wrote the examination answered **question 40** correctly. About 13% of the females and 24% of the males who wrote the examination chose alternative D. Of the three incorrect answers, alternative D was chosen most frequently by both males and females. However, females in comparison to males are likely to have more 'real life' knowledge of technologies that can be used to monitor fetal development.

Of all of the questions on the examination, these questions showed the most significant difference in results by gender.

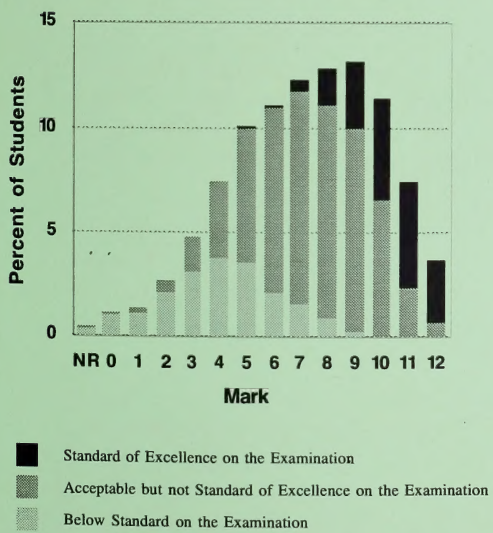
Written-Response Questions

Responses to the written-response questions indicated that most students approached the examination seriously. Of the students who wrote the examination, 0.6% received no marks for both written-response questions, 65.7% received 12 marks or more out of 24, and 14.7% received 20 marks or more out of 24.

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1: This process skill question, which related to a clinical study of the effects of hypothyroidism on males, was attempted by almost all students (99.5%) who wrote the examination.

Most of the subparts of the question required students to interpret observations and then provide conclusions or hypotheses that could be inferred from those observations.

In parts *a* through *d*, most students demonstrated the ability to extract information from data tables, accurately evaluate these data, and relate this new information to concepts studied in Biology 30.

In part *b*, most students demonstrated an understanding of negative feedback between thyroxine and TSH.

In part *e*, most students demonstrated good graphing skills. Some students incorrectly used the X axis for the responding variable and the Y axis for the manipulated variable.

In part *f*, some students did not make the connection between decreased metabolic rate in men with hypothyroidism and reduced sperm production.

In part *g*, many students attempted incorrectly to relate the production of FSH to the production of testosterone.

On this 12-mark question, the average mark was 7.15 or 59.6%.

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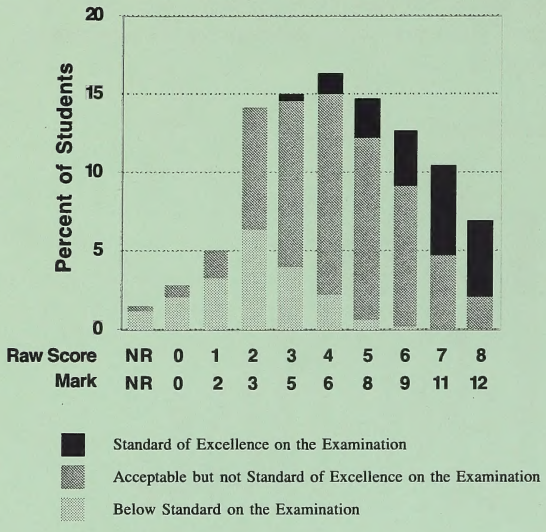
Distribution of Marks for Question 2



Question 2: This extended-response question was attempted by 98.4% of the students who wrote the examination. The question required students to evaluate the proposal that people with genetic abnormalities should not be discouraged from having families, that doctors should attempt to treat every genetically related health problem, and that doctors should attempt to keep people with genetic abnormalities alive at all cost. Students were asked to describe technologies that would reduce the cost of initiating such a proposal and to argue for and against the proposal from the perspective of a geneticist and from the perspective a policy maker.

Most students identified three appropriate technologies and described at least one of these. Some students seem to think that technologies exist that can be used to do far more than is actually possible at this time.

Most students were able to present a balanced argument from a policy maker's perspective, but many had difficulty presenting a negative argument from a geneticist's perspective. Some students inappropriately presented biased arguments from their own perspective.

Limited organizational and communication skills were evident in some student responses.

About 39% of the student population failed to achieve the acceptable standard on this question. This indicates that further attention must be given to the STS component of the Biology 30 program.

This question was marked holistically. Two markers read each response. Each marker assigned a score from 0 to 4. These scores were added to obtain a raw score from 0 to 8. This raw score was then converted to a mark out of 12. On this 12-mark question, the average mark was 6.35 or 52.9%.

For further information, contact Dave Bridgewater or Lowell Hackman at the Student Evaluation Branch, 403-427-0010.